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ABSTRACT

The relative difficulty levels of Stanford-Binet items between the ages of four and six among prekindergarten Head Start children were studied. A comparison sample of prekindergarten white middle class children was included to evaluate the age norms on a culturally typical sample of children and to assess performance on the Binet as it might relate to cultural differences. The analyses required that the items be arranged in order of difficulty and then examined for the degree to which the reordered items appear in their assigned age groups. Similar analyses were conducted for all groups to determine variables due to sex and race differences. Results suggest that the age progression properties of the items are relatively consistent between lower and middle-class children, between males and females of either SES, and between races among lower class children; however, the age-placements of many items on the 1960 revision appear inappropriate, although the negative influence of such items is distributed evenly over SES, race and sex. Examples of item misplacement are discussed. (Author/LR)

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William J. Meyer and David Goldstein

A basic assumption underlying the Standord-Binet (SB) is that the items form an age progression. Operationally, the assumption of age-progression means that, for a given age group, successively fewer items will be passed at each older age level, and that more items will be passed at each younger age level. It is also assumed that the percentage of children passing any one subtest at the older level will be lower than the percentage passing items at the appropriate, or younger, age level. Finally, it is assumed that the age progression results from the emergence of maturational processes, assuming that environment is held reasonably constant.

Criticisms of the SB typically focus on the assumption that environmental variation contributes little to performance variation. The items, for example, may sample from experiences that are not relevant to the inner-city child therefore penalizing those children. One might also argue that the age placement of items may penalize the deprived child; that is, the relative difficulty levels of the items might be more divergent from the established norms than is the case for middle-class children. This possibility is perhaps more crucial for the SB because this test assumes that a child will not pass any items beyond the age level at which all subtests were failed.

Similarly, the establishment of a "basal age" requires the child to pass all subtests at a particular age level or else subtests at the next younger age level must be given. This last situation could result in substantially longer testing time which, in turn, could

Table 1

Sample Description

	N	Mean CA	SA CA	Mean IQ	SD IQ
MC (Total)	92	52.4	4.1	108.6	12.8
HS-Pre (Total)	97	63.7	5.9	83.8	15.4
HS-Post (Total)	92	64.5	5.9	88.6	15.1
HS-Pre Males	49	63.3	5.8	86.2	15.9
HS-Pre Females	48	64.1	5.9	81.3	14.5
MC-Males	43	52.9	3.9	104.9	11.9
MC-Females	49	51.9	4.2	111.8	12.7
HS-Post Males	49	64.1	5.8	91.6	15.6
HS-Post Females	42	64.9	6.2	85.6	13.9
HS-Pre Black	61	64.1	6.0	81.1	13.5
HS-Pre White	36	62.9	5.7	88.2	17.3
HS-Post Black	58	64.7	6.2	85.8	13.3
HS-Post White	33	64.1	5.8	94.2	16.6

adversely affect performance.

This study examined the relative difficulty levels of SB items between the ages of four and six among prekindergarten Head Start children. A comparison sample of prekindergarten white middle-class children was also included in the study for the purpose of evaluating the age norms on a culturally typical sample of children. The middle-class sample also permits an assessment of performance characteristics on the SB as they might relate to cultural differences.

Method

Subjects

The sample consists of 93 Head Start children and 92 middle-class children. Table 1 shows the Ns, mean CAs and IQs, and relevant DSs for the total sample and by race and sex. The Head Start youngsters are about 12 months older than the middle-class sample which is a statistically significant difference (t = 5.08 df = 182 $p > .001$). Differences between the groups on IQ were also statistically significant (t = 3.62 df = 182 $p > .01$).

Procedure

The SB, Form LM, was administered to both groups by experienced examiners as part of a general evaluation program. Each Head Start child was given both a pre- and a posttest SB but the middle-class children received only one test. Examiners were randomly assigned to children.

Results

The analyses required that items be arranged in order of difficulty and then examined for the degree to which the reordered items appear in their assigned age grouping. The percent passing each item was determined for all items between Year IV and Year VI and these

Table 2

Percent and Rank Orders
of Binet Items Years IV-VI
of Head Start and Middle-Class Children

	Year IV						Year IV-6					
Items	1	2	3	4	5	6	1	2	3	4	5	6
Total Middle-Class												
%	64	84	86	91	92	75	78	67	84	68	71	77
Rank	14	4.5	3	2	1	9	6	13	4.5	12	11	7
Total HS pre-Test												
%	53	84	64	76	80	51	73	38	67	27	61	61
Rank	11	1	7	3	2	12	4	15	6	18	9	9
Total HS posttest												
%	61	95	76	88	87	75	89	58	80	42	78	71
Rank	12	1	8	3	4	9	2	13	5	16	6.5	11
Male Middle-Class												
%	65	81	79	86	88	74	72	54	70	70	65	72
Rank	11.5	3	4	2	1	5.5	7.5	14	9.5	9.5	11.5	7.5
Female Middle-Class												
%	63	86	92	96	96	76	84	80	96	67	76	82
Rank	14.5	5.5	4	2	2	11.5	7	9	2	13	11.5	8
Male Head Start Pre												
%	55	90	67	67	86	55	74	41	67	27	67	67
Rank	11.5	1	6	6	2	11.5	3	14	9	18.5	6	6
Female Head Start Pre												
%	50	77	60	86	75	46	73	36	69	31	54	54
Rank	11	2	8	1	3	12	4	15	5.5	16	9.5	9.5
Negro Head Start Pre												
%	46	84	57	72	82	44	72	28	67	30	59	59
Rank	12	1	10	3.5	2	13	3.5	16.5	6	15	8.5	8.5
White Head Start Pre												
%	64	83	75	83	78	61	75	56	67	28	64	64
Rank	8.5	1.5	4.5	1.5	3	11.5	4.5	13	6	19	8.5	8.5

Male HS Posttest

	Year IV						Year IV-6					
Items	1	2	3	4	5	6	1	2	3	4	5	6
%	59	96	76	88	88	76	86	59	82	45	82	80
Rank	12.5	1	9.5	2.5	2.5	9.5	4	12.5	5.5	15.5	5.5	7

Female HS Posttest

%	64	93	77	89	86	75	93	57	77	39	75	61
Rank	11	1.5	6.5	3	4	8.5	1.5	14	6.5	16	8.5	12

Negro HS Posttest

%	57	93	72	87	87	67	90	50	73	42	77	63
Rank	13	1	9	3.5	3.5	10	2	14	7.5	15	6	11

White HS Posttest

%	70	97	85	91	88	91	88	73	91	42	82	85
Rank	13	1	7.5	3	5.5	3	5.5	11	3	18	9	7.5

Table 2 (Con't.)

Middle Class

Items	Year V 1	2	3	4	5	6	Total 1	2	Year VI 3	4	5	6
%	53	51	76	22	73	20	26	15	30	14	33	24
Rank	15	16	8	21	10	22	19	23	18	24	17	20
						Total HS pre-test						
%	39	44	68	33	61	24	8	12	21	8	6	30
Rank	14	13	5	16	9	19	22.5	21	20	22.5	24	17
						Total HS posttest						
%	43	57	78	38	73	39	11	19	25	16	15	27
Rank	15	14	6.5	18	10	17	24	21	20	22	23	19
						Male Middle-Class						
%	42	47	74	21	58	12	19	12	35	7	28	28
Rank	16	15	5.5	20	13	22.5	21	22.5	17	24	18.5	18.5
						Female Middle-Class						
%	63	55	78	22	86	27	33	18	27	20	37	20
Rank	14.5	16	10	21	5.5	19.5	18	24	19.5	22.5	17	22.5
						Male HS Pre						
%	39	47	67	39	59	22	12	18	27	10	8	37
Rank	15.5	13	6	15.5	10	20	22	21	18.5	23	24	17
						Female HS Pre						
%	40	42	69	27	62	25	4	6	15	6	4	23
Rank	14	13	5.5	17	7	18	23.5	21.5	20	21.5	23.5	19
						Negro HS Pre						
%	34	48	70	28	61	25	10	8	13	7	3	26
Rank	14	11	5	16.5	7	19	21	22	20	23	24	18
						White HS pre						
%	47	39	64	42	61	22	6	20	33	11	11	36
Rank	14	16.5	8.5	15	11.5	20	24	21	18	22.5	22.5	16.5
						Male HS Posttest						
%	41	55	78	41	74	45	16	27	37	22	20	29
Rank	17.5	14	8	17.5	11	15.5	24	21	19	22	23	20
						Female HS Posttest						
%	46	59	80	34	73	32	4	11	11	9	9	25
Rank	15	13	5	17	10	18	24	20.5	20.5	22.5	22.5	19
						Negro HS Posttest						
%	40	58	82	33	73	35	8	20	17	17	5	25
Rank	16	12	5	18	7.5	17	23	20	21.5	21.5	24	19
						White HS Posttest						
%	48	55	73	46	73	46	15	18	40	15	33	30
Rank	15	14	11	16.5	11	16.5	23.5	22	19	23.5	20	21

Table 3

Stanford-Binet Item
Analysis

Item	Description
1	Picture vocabulary
2	Objects from memory
3	Opposite analogies I
4	Picture identity
5	Discriminating forms
6	Comprehension II
7	Aesthetic comprehension
8	Opposite analogies II
9	Picture similarities and differences I
10	Materials
11	3 commissions
12	Comprehension III
13	Picture completion: man
14	Folding triangle
15	Definitions
16	Copying square
17	Picture similarities and differences II
18	Patience: rectangles
19	Vocabulary
20	Differences
21	Multiple pictures
22	Number concepts
23	Opposite analogies II
24	Maze
25	Picture absurdities I
26	Similarities: 2
27	Copying diamond
28	Comprehension IV
29	Opposite analogies III
30	5 digits

data are summarized in Table 2. (Table 3 shows the item title and corresponding item numbers used in Table 2). Inspection of the data for the total groups suggests that, despite the misplacement of some items, the relationships among the rank orderings of items is high. This is in fact the case: the rank order correlation (rho) between the Head Start pretest and the middle-class group is .90: the correlation with the posttest is .92. Similarly, within the Head Start group the rhos for race and sex are .96 and .93, respectively. The rank correlation between the sexes within the middle-class group is .88. These data permit the conclusion that the relative difficulty levels of the item difficulties are quite consistent in terms of race, sex, and socioeconomic status.

Despite the high relationships between item difficulties, it should be noted that, on the pretest, more middle-class children passed each item than Head Start children (21 MC, 2 HS, 1 Tie). The two exceptions occur on Copying-a-Square (Year V) and Maze Tracing (Year VI). A similar comparison involving the posttest indicates a rather dramatic change: 12 MC, 10 HS, 1 Tie· that is, in terms of percent passing an item, the Head Start children catch up to the middle-class children. It is perhaps worthwhile to note the items where the largest gains occur: Comprehension III (Year IV) 24% $p > .06$: Opposite Analogies I (Year IV-6) 20% $p > .10$: Three Commissions (Year IV-6) 17% $p > .13$ and Aesthetic Comparison (Year IV-6) 16%, $p > .14$. It should be kept in mind that the middle-class children are 12 months younger than the Head Start group and yet they maintain a slight superiority in performance on the SB items. Of particular interest is the fact that some 26% of the middle-class group pass the Vocabulary item (Year VI) while only 8% (pretest) and 11% (posttest) of the Head

Start children pass this item (the difference between 26% and 11% is statistically significant, $p > .001$). Despite the verbal superiority of the middle-class children, it is interesting that their performance on perceptual-motor items (Square, Year V Patience, Year V) is not consistent with their verbal ability. The Head Start children perform better on both of those subtests each of which is superior to their vocabulary performance.

Table 2 also permits an evaluation of the appropriateness of the item age placements. These data were examined in terms of the rankings of the items in which it is anticipated that ranks 1-6 occur at Year IV, ranks 7 - 12 at Year IV-6, ranks 13 - 18 at Year V, and rank 19 - 24 at Year VI. Using this criterion there are 11 misplaced items for the middle-class children and 11 on the pretest and 10 on the posttest for the Head Start children. The fewest misplaced items occur at Year VI and the most occur at Year IV-6 for the Head Start children and Year V for the middle-class children. Obviously the ranking procedure is very stringent because it assumes homogeneity of item difficulties within an age category--a situation which clearly does not exist in either of our samples but neither does it exist in the 1937 standardization sample (McNemar, 1942, pp. 90-93). Thus in a very real sense the ranking strategy may be unfair. Nevertheless, it does show that within an ability level group, some items are easier than others. Picture Vocabulary (Year IV) for example, is a harder item for both samples than either Definitions or Pictorial Similarities and Differences both of which appear at Year V.

Another strategy in evaluating age appropriateness of items is

Table 4

Percentages of Items Passed at
Each Age Level

	MC	Pre Head Start	Post Head Start
IV	82	68	80
IV-6	74	55	70
V	49	45	55
VI	24	14	19

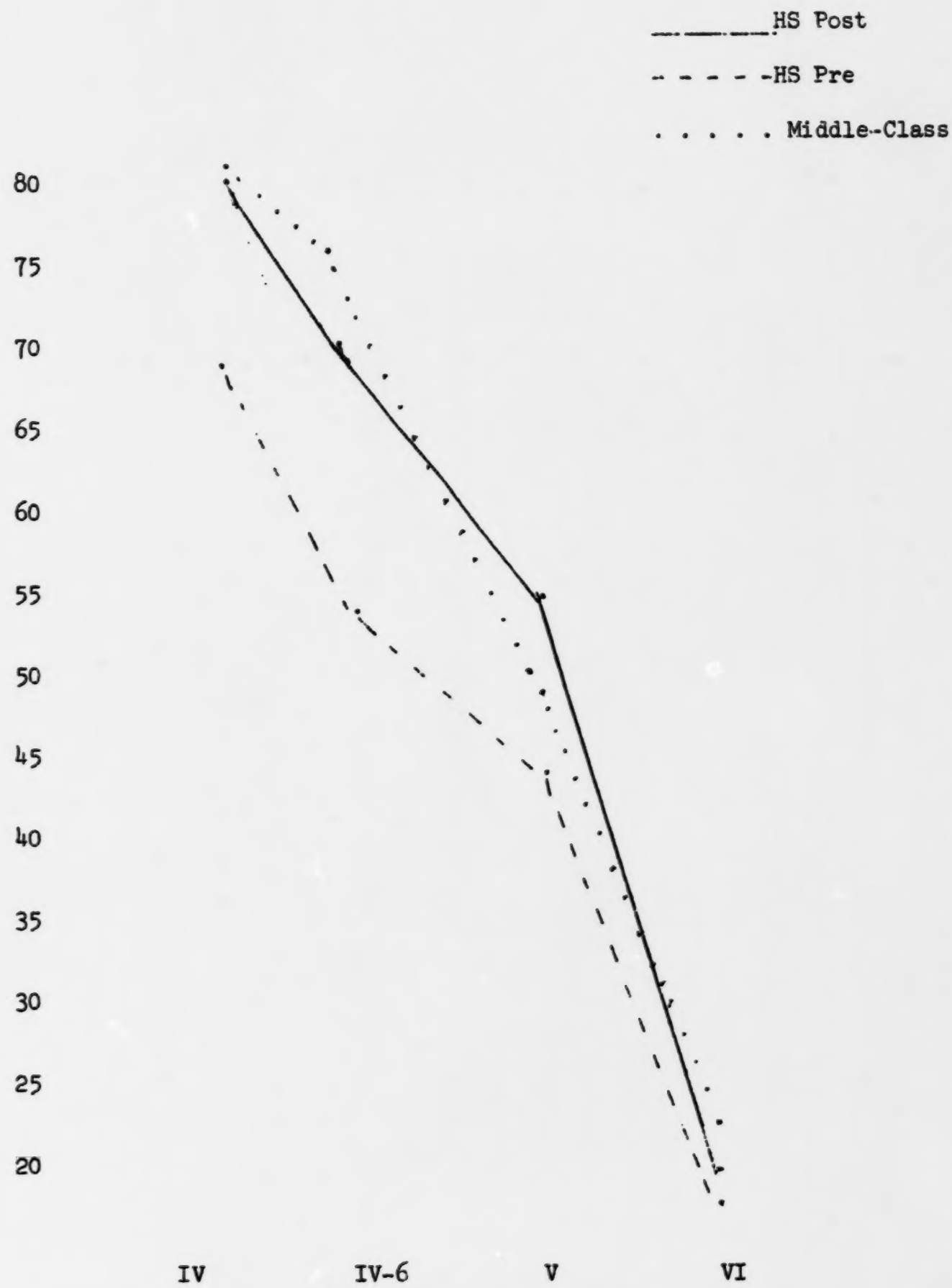

Figure 1
Percent Passing Items at
Each of Four Age Levels
on the SB

to examine the percent passing the items within each age level. This procedure involved adding the number of children passing all the items within an age level and dividing by the total number of possible passes (6 x N). The resulting percentages are summarized in Table 4 and are graphically shown in Figure 1.

Several items of interest can be seen from Figure 1. First the Head Start group made the greatest gains in terms of percent passing an item, at Year IV, IV-6, and V and a negligible gain at Year VI. These data show that whatever variables produce change, the changes are almost entirely concentrated on items below the children's age level. Notice that at Year VI, the gain in items passed is only three percent and, despite the age difference. performance at this age level is below that of the middle-class children. Secondly, Figure 1 suggests an approximate linear descending function of percent passing the items; that is, the age progression of the items is essentially linear. A possible divergence from this trend occurs for the pretest Head Start data where the decline in percentages between Years IV and IV-6 is somewhat less than the subsequent change. Finally, Figure 1 shows that the posttest performance of the Head Start children is essentially similar to that of the middle-class group. However, the middle-class children are both younger and brighter with the net effect that the Head Start children are between 18 and 24 months behind.

Sex and Race Differences

Essentially the same analyses were run for the sex and race variables as were reported for the total groups. Since there were no black children in the middle-class group it was not possible to include that group in the race analysis. Table 5 summarizes the percentage of items passed at each of the four age levels by black

and white children for both the pre-and posttest situations. These data indicate that a greater percentage of white children pass the

Table 5
Percent Black and White Children Passing Items
at Each of Four Age Levels on the SB

	Pretest		Posttest	
	Black	White	Black	White
IV	64	74	77	87
IV-6	52	59	66	77
V	44	46	54	56
VI	11	19	15	25

items at each age level and that the percentage gains for each racial group is approximately equal. The rank order correlations between item difficulties for each race are .92 and .93 for pre- and post-items respectively. In terms of items misplaced in ranking within an age level, there are 12 and 10 and 11 and 8 misplaced items for black and white children on the pre- and posttests. respectively. It may be of interest to note where the larger discrepancies occur. Opposite Analogies I (IV) ranks tenth for blacks and 4.5 for whites Materials (IV-6) ranks fifteenth for blacks and nineteenth for whites Pictorial Similarities and Differences II (V), ranks 7 for blacks and 11.5 for whites; and Folding Triangle (V) ranks 11 for blacks and 16.5 for whites.

Table 6 summarizes the percent passing items at each age level by sex and includes the middle-class group as well as the pre- and posttest performances of the Head Start children.

Table 6

Percent Males and Females Passing Items at Each of Four Age Levels for Middle-Class and Head Start Children

	Middle-Class		Pretest Head Start		Posttest Head Start	
	M	F	M	F	M	F
IV	79	85	70	66	80	81
IV-6	67	81	56	53	72	67
V	42	55	45	44	55	54
VI	21	26	19	10	25	12

With respect to the middle-class children, it is clear that girls perform better at each age level with the greatest differences occurring at Years IV-6 and V. The rank order correlation between difficulty levels is .88 indicating substantial agreement in relative item difficulties. In terms of misplaced items derived from rank orders, six and 10 items are misplaced for males and females, respectively. Discrepancies in rank orders occurred on the following items: Comprehension II, Year IV, (boys rank 5.5, girls rank 11.5), Opposite Analogies II, Year IV-6 (boys rank 14, girls rank 9). Picture Similarities and Differences I, Year IV-6 (boys rank 9.5 girls rank 2). Definitions, Year V (boys rank 5.5, girls rank 10), and Picture Similarities and Differences II. Year V (boys rank 13. girls rank 5.5).

Within the Head Start group, there occurs a curious reversal in the percentages passing items that is, with one exception more boys pass items than girls. This reversal may not reflect more than a sampling error. The rank order correlations between the rank-difficulty levels for each sex are .95 and .96 for the pre- and posttests respectively. On the pretest there are 10 and 7 misplaced items for males and females, respectively: on the posttest there are 10

misplaced for males and 7 for females.

Discussion

The results of this study suggest that the age progression properties of the items on the SB are relatively consistent between lower- and middle-class children- between males and females of either SES- and between the races among lower-class children. The data also indicate that the age-placements of many items are inappropriate suggesting that the procedures employed in developing the 1960 revision have produced a less than perfect instrument. It is of course unclear from this study the degree to which a child's score is influenced by these difficulties. We can conclude, however, that the negative influence is distributed evenly over SES, race and sex.

There are obviously at least two confounding variables in this study which restrict the generalizability of the results. First, the Head Start sample is a full 12 months older than the middle-class sample and, secondly, the middle-class children achieve significantly higher IQ scores. It is quite possible, for example, that if the middle-class children were a year older they would not have experienced the same level of difficulty with Picture Vocabulary, Year IV. But it is also conceivable that performance on the other items would have increased so that the relative difficulty of the Picture Vocabulary would have remained the same. Although the between SES comparison is confounded, comparisons within SES groups are valid and those conclusions, at least, seem valid.

It may be instructive to examine more closely the nature of the items which seem misplaced. The Picture Vocabulary item stands out, for all groups as one item which is more difficult (in terms of percent passing) than the 11 other items occurring at Year IV and Year IV 6.

Examiners frequently report that the scoring criteria are too rigid (item 15, for example, requires two responses out of a possible three whereas all other items require a single word). The Materials item (Year IV-6) was quite difficult for the Head Start children but not the middle-class children. This may be the single item among the 24 studied that reflects an SES bias (68% vs 42%): that is, the Head Start children may be less familiar with the materials involved in a house, window, or book. There were also two items which were, in a sense, too easy for the children. Definitions (Year V) and Picture Similarities and Differences II (Year V).

There is a pattern of performance which emerges from the data which admittedly relies on some as yet well tested assumptions but which might serve as a point of departure for the future research. Examination of Figure 1 for post Head Start and middle-class shows essentially identical performance at Year IV, slight superiority for the middle-class at Year IV-6 slight superiority for Head Start at Year V, and slight superiority for the middle-class at Year VI. At Year IV-6, the middle-class are better on four of the six items (Picture Similarities and Differences I, 84% vs 80% Opposite Analogies II, 67% vs 58%: Materials, 68% vs 42%: and Comprehension III, 77% vs 71%). Notice that three of the four items require the ability to abstract: that is, the child must possess abstract representational ability. The Head Start children were better on Aesthetic Comparison (78% vs 89%) and 3 Commissions (71% vs 78%) both of which do not require very much representational ability. This picture is further supported at Year V where the Head Start children were superior on three of six tests: Folding Triangle (51% vs 57%), Copying Square (22% vs 38%) and Patience Rectangles (20% vs 39%). The middle-class

children were superior on the Picture-Completion Test (53% vs 43%) which, in theory at least, requires representational ability. No differences existed on the remaining items. Finally at Year VI the middle-class children performed better on Vocabulary (26% vs 11%) and Opposite Analogies III (33% vs 15%) with no other substantial differences occurring on the other items.

What is interesting about these patterns of items is that both SES groups experience difficulty on the more abstract (representational) items but the Head Start children are especially troubled by these items. This interpretation of the performance patterns is consistent with the more formal findings reported by Sigel and his associates (Sigel and McBane, 1967; Sigel, 1968; Sigel, Anderson, & Shapiro, 1966). Thus young children, in general, experience increasing difficulty as the cognitive demands of the items become more and more abstract; lower-class children, however, experience greater difficulty. The SB is sensitive to this developmental difference as early as the IV-6 age level. Assuming that the developmental rate is not altered and, following Hofstaetter's (1954) data, that IQ tests shift toward more abstract cognitive tasks at older age levels, it is not surprising that lower-class children show IQ declines shortly after the preschool years. Whether or not compensatory education can successfully modify this component of cognitive development remains to be seen.

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